

in contact is effected by an interchange in position of indefinitely minute volumes of the gases, which volumes are not necessarily of equal magnitude, being in the case of each gas inversely proportional to the square root of the density of that gas." He speaks of diffusion "being effected by a force of the highest intensity," and insists that diffusion takes place between the *ultimate particles of gases*, and not between sensible masses. In a later paper, *Phil. Trans.*, 1863, he states that molecules only of gas can pass the pores of graphite, "and they may be supposed to pass wholly unimpeded by friction." He showed that a gas may pass into a vacuum in four ways, first by effusion, a movement which affects *masses* of gas only, second, by diffusion which affects *molecules*, third, by transpiration through capillary tubes, "the transpiration ratios forming a class of phenomena remarkably isolated from all else at present known of gases," and lastly by a previous absorption in the walls of the septum which divides the gas from the vacuous space, as was so beautifully shown in the papers published in the years 1866-69. In one of these, in considering the passage of gas through metallic septa, he recognises "an intermolecular porosity due entirely to dilatation at a high temperature," and thus apparently hoped to ascertain the ultimate size of molecules, for he says that this "species of porosity, if it exists, might well be expected to throw light on the distances of solid molecules at elevated temperatures."

His views are very clearly defined in a paper published in 1863 entitled "Speculative Ideas respecting the Constitution of Matter." He is of opinion that the various kinds of matter now recognised as different elementary substances may possess one and the same ultimate or atomic molecule existing in different conditions of movement. Were this ultimate atom at rest, the uniformity of matter would be perfect; but it always possesses motion, due to a primordial impulse, and, as differences in the amount of this motion occasion differences of volume, matter only differs in being lighter or denser matter. The gaseous molecule is composed of a group of the preceding inferior atoms following similar laws and is thus a reproduction of the inferior atom on a higher scale. Chemical combination consists in equal volumes of the different forms of matter coalescing and forming a new atomic molecule, and is therefore directly an affair of weight; and the combining weights differ because the densities, atomic and molecular, differ. Graham is further careful to point out that liquefaction and solidification probably only involve a restriction of the range of the atomic movement.

In this brief sketch it has not been possible to touch on his views as to states of matter, such, for instance, as the "colloidal condition which intervenes between the liquid and crystalline states," or to the more purely chemical portion of his work, of which his theory of polybasic acids is probably the most remarkable.

Widely as the value of Graham's work was recognised during his lifetime, there is no doubt that the appreciation of it is increasing, and cannot fail to be stimulated by Mr. Young's liberality, which has set forth the researches in such a manner as to impress us with their coherence and strength.

W. CHANDLER ROBERTS

#### THE ANDES AND THE AMAZON

*The Andes and the Amazon; or, Across the Continent of South America.* By James Orton, A.M., Professor of Natural History in Vassar College, U.S., &c. Third Edition, Revised and Enlarged, containing Notes of a Second Journey. Maps and Illustrations. (New York: Harper Brothers, 1876.)

AS is indicated in the title this work contains accounts of two separate journeys, to a considerable extent over the same ground, the first undertaken in 1867, the second in 1873. A narrative of the former was published several years ago both in America and in England, we believe; the second half of the volume is quite new and is essentially supplementary to the former. The results of the journey of 1867 are given in the form of a personal narrative, those of 1873 are arranged systematically in a number of chapters on the various features of the Amazon and its surroundings. The main scientific results of both expeditions have been described in the *Proceedings* of various scientific societies and in scientific journals in America and in England, and the present volume is therefore perfectly free from any details that would prove unattractive to the general reader.

In the journey of 1867 Prof. Orton and party landed at Guayaquil in Ecuador, mounted the Andes to Quito, proceeded by Papallacta, Baeza, and Archidona, still among the Andes, to the Napo river. Floating down this river they reached the Amazon, took steamer at Pebas, and enjoyed a splendid sail to the mouth of the river at Pará. In the second journey, that of 1873, Prof. Orton landed at Pará and sailed up the great river to Yurimaguas, thence over the Andes to the Pacific Coast and down to Lima, with a side-excursion to Lake Titicaca by way of Arequipa.

Prof. Orton tells his story in most attractive style. He is in danger sometimes, no doubt, of degenerating into the florid, but from beginning to end of his large volume he never ceases to be attractive, amusing, and instructive. He writes on people and things in the wonderful region of the Amazon with great piquancy, genuine humour, and full knowledge; he frequently becomes absolutely eloquent, if not poetic. Few features of the towns and the country through which he passed have escaped his attention. In describing his first journey, he lingers at Quito for several chapters, describing the city, giving hints and comments on its history, touching off the appearance and character of its easy-going people, giving an account of the country of which it is the capital, Ecuador, the flora and fauna and primeval inhabitants of the Valley of Quito, rising thence to an eloquent dramatic sketch, *à la* Hugh Miller, of the geological history of South America, the rise of the Andes, and the creation of the Amazon, devotes two interesting chapters to the volcanoes of Ecuador and its earthquakes, and before leaving, gives several details about a few of the Indian tribes in "the Province of the Orient." So on his way down the Napo and the Amazon, he paints vividly and picturesquely the scenery, the people, the animals, the plants, and the geology of one of the most interesting regions in the world. He chats pleasantly and piquantly of all he comes across, never gives the reader a chance of feeling wearied, and leaves him, if he has been a faithful

listener, with a fuller and clearer knowledge of the Amazon and its tributaries, its basin, its products, its people, its cities, and fragments of towns, its industries, and its probable future, than he could get from reading many other books. The second part especially, containing the results of the journey of 1873 systematically arranged, will be found extremely handy and valuable by anyone who desires in brief space a general view of the physical geography, natural history, ethnology, industrial resources, commerce, prospects, and scenery of the vast Amazonian region. Prof. Orton has evidently supplemented his personal knowledge of the region by an extensive study of the contributions of others who have written on the subject, so that while the classical works of Bates and others, as well as the special papers of Prof. Orton himself, will be resorted to by those who desire to make a thorough study of the Amazonian basin, we know of no single work containing a fuller, more brilliantly written, and at the same time more trustworthy general account of the basin of the Amazon and its many wonders. The following extract on the density of population in the Amazonian valley will give our readers some idea of the style of the work:—

"The valley of the Amazons is probably the most thinly-peopled region on the globe, save the great deserts and the polar zones. There are not 40,000 souls along the banks of the rivers in the whole province of Amazons and the Lower Marañon. Many of the towns marked on the maps do not exist, or are represented by a solitary palm-hut. The visible population is almost confined to the circumference of the valley; as at Pará, near the mouth of the river; at Moyobamba and Tarapoto, on the oriental side of the Andes; and at Trinidad, Santa Cruz, Cochabamba, and La Paz, on the head-waters of the Madeira. The great basin is filled with a continuous, dark, primeval forest, rarely disturbed by the hand of man, and into which daylight seldom enters. Yet imagination peoples this pathless wilderness with uncounted swarms of savages. There are, it is true, numerous clans (we can hardly call them tribes) of Indians, distinct in language, and often hostile toward each other. But many of these so-called tribes, though dignified with separate names, are insignificant in numbers, barely mustering a hundred; while the Mundurucú, the largest known tribe in the valley, does not exceed 8,000—men, women, and children. Nor are there any remains of ancient walls to indicate a bygone civilisation, or even shell-heaps in memory of a more primitive race.

"Until the close of the Tertiary age the waters prevailed over this heart of the continent; and since then vegetation has had the mastery, leaving little chance for animal life. And until there is a decided change in the physical geography of the valley, a large part of it must remain unfit for permanent settlement, on account of the annual floods; for a rise of 40 feet in the river drives the inhabitants from their summer resorts on the margin of the streams to the higher *terra firma* within the forest. In this way nomadic habits are engendered or perpetuated, and poverty is almost inevitable, for half the year (flood-time) it is hard work to get a living. Furthermore, this regular inundation of the country and the lack of grassy campos (except on the Lower Amazons and the Beni region) prevent the raising of domesticated animals, which, if it does not lie at the foundation of agriculture, certainly does aid in the transition from the savage to a semi-civilised state. In this respect the natives of Central Asia and Africa, as well as the maize-eating tribes of the Andes, have an advantage over the mandioca-eating Indians on the Amazons."

While minute criticism might find many statements

and hypotheses in Prof. Orton's work to challenge; while some of his chapters may be considered by the lover of severity of style as intolerably florid; while in short anyone who has a mind to might find something to object to, we are sure that all into whose hands the work may fall will agree that few more attractive and at the same time more instructive works of travel have been written. Prof. Orton seems to anticipate that ere long the Amazon will become a highway for tourists, as it well might—even now it has a considerable service of steamers—and therefore gives many hints, directions, and statements of expense that render his work valuable as a guide-book. Not the least attractive feature are the many well-executed illustrations of places, people, scenery, and animal and plant life that enrich the volume. Two large maps, one of the Marañon and its tributaries and the other of Equatorial America; add to the value of the work, which will doubtless be brought within reach of the English reading public by some enterprising publisher.

#### OUR BOOK SHELF

*The Secret of the Circle, its Area Ascertained.* By Alick Carrick. Second Edition. (H. Sotheran and Co., 1876.)

*The Impossible Problem.* By James Alexander Smith. Printed for the Author's Use. (Shaw and Sons, 1876.)

THE only difference we have been able to detect between this edition and its predecessor are that the last lines of pp. 34 to 38 of the first edition are the first lines of pp. 35 to 39 of the second edition, with the corresponding changes of the other lines of the several pages, that a date has been omitted on p. 39, and fig. 2 on p. 41 slightly modified. With our copy we were favoured with a number of *The Welshman* (Sept. 29, 1876) containing a very long notice of it, supplied to the editor of the paper by an enthusiastic admirer of the work. An extract or two will sufficiently illustrate the article. "Don't let the reader run away with the idea that this is a prelude to any long, complicated calculations, understandable only by the initiated. As simple as truth itself, when ascertained, the solution of this problem is as easy and capable of absolute proof as any ordinary sum in addition and subtraction." "This beautiful problem and mystery that has tempted, attracted, and defeated the skill of thousands of the most subtle and far-seeing minds for thousands of years is found, when looked at in the right way, to be as easy and as simple as the alphabet." "It will not suffice for mathematicians to endeavour to show by any fallible and inadequate system of computation now in vogue that this result cannot be. The reader can judge for himself."

We in our former notice pointed out what we considered defective in Mr. Carrick's proof. The work is a posthumous one, hence it is that the second edition has experienced no revision at the author's hands.

Mr. Smith, in his pamphlet (8 pp.), arrives at the same result as Mr. Carrick, viz., that  $\pi = 3\frac{1}{4}$ , or the area of the circle equals  $\frac{3}{4}$  of the square of the diameter  $+ \frac{1}{28}$  of that square. The roads pursued are different.

Though we cannot agree with Mr. Smith, we have read his work with some interest, for there are some neat little pieces of simple construction in it. His equations on p. 5 may be put into the more general form:—

$$w = (3 + \frac{1}{4})x, y = (\frac{3}{2} + \frac{1}{4})x, z = (\frac{3}{2} + 2\frac{1}{4})x.$$

We have not been able to see, if other values would satisfy his equations besides the one he has selected, which leads him to draw the conclusion he does,